Psychological Services

Veterans Affairs and the Department of Defense Mental Health Apps: A Systematic Literature Review

Christine E. Gould, Brian C. Kok, Vanessa K. Ma, Aimee Marie L. Zapata, Jason E. Owen, and Eric Kuhn

Online First Publication, November 15, 2018. http://dx.doi.org/10.1037/ser0000289

CITATION
Gould, C. E., Kok, B. C., Ma, V. K., Zapata, A. M. L., Owen, J. E., & Kuhn, E. (2018, November 15). Veterans Affairs and the Department of Defense Mental Health Apps: A Systematic Literature Review. *Psychological Services*. Advance online publication. http://dx.doi.org/10.1037/ser0000289

American Psychological Association

Psychological Services

In the public domain

http://dx.doi.org/10.1037/ser0000289

Veterans Affairs and the Department of Defense Mental Health Apps: A Systematic Literature Review

Christine E. Gould
VA Palo Alto Health Care System, Palo Alto, California, and Stanford University School of Medicine

Brian C. Kok, Vanessa K. Ma, and Aimee Marie L. Zapata
VA Palo Alto Health Care System, Palo Alto, California, and Palo Alto University

Jason E. Owen
VA Palo Alto Health Care System, Menlo Park, California

Eric Kuhn
VA Palo Alto Health Care System, Menlo Park, California, and Stanford University School of Medicine

In the present systematic review, we summarize the feasibility, usability, efficacy, and effectiveness of mental health-related apps created by the Veterans Affairs (VA) or the Department of Defense (DoD). Twenty-two articles were identified, reporting on 8 of the 20 VA/DoD mental health self-management and treatment companion apps. Review inclusion criteria were studies that reported original data on the usability, acceptability, feasibility, efficacy, and effectiveness, or attitudes toward the app. We collected data from each article regarding type of study, sample size, participant population, follow-up period, measures/assessments, and summary of findings. The apps have been tested with patients seeking treatment, patients with elevated mental health symptoms, and clinicians. The strongest area of support for the apps is regarding evidence of their feasibility and acceptability. Research support for efficacy and effectiveness of the apps is scarce with exceptions for two apps (PTSD Coach, Virtual Hope Box). Until more evidence accumulates, clinicians should use their judgment and be careful not to overstate the potential benefits of the apps.

Keywords: military, mobile application, technology, veteran

More than three quarters of American adults own a smartphone capable of using mobile applications (apps; Smith, 2017). The extensive reach of mobile apps may be one way to disseminate mental health information to those in need. Mental health apps can deliver psychoeducation, facilitate symptom monitoring, teach symptom management skills, and provide tools to facilitate treatment adherence (World Health Organization, 2012). Such apps could enhance patient care by providing low intensity interventions to those who may not be ready, interested, or able to engage in higher intensity mental health treatment. Furthermore, incorporating apps into existing health care systems may increase access to services particularly for patients who are unable to initiate treatment due to work schedules, family/caregiving duties, or geographical distance (e.g., rural areas). Mobile apps also may increase patients' acceptance of mental health treatment referrals (Possemato, Kuhn, Johnson, Hoffman, & Brooks, 2017), enhance evidence-based treatments (e.g., Luxton, McCann, Bush, Mishkind, & Reger, 2011), or facilitate patient autonomy (e.g., promote self-management of symptoms). Thus, apps have the potential to be used in a variety of ways across multiple settings by patients, caregivers, and clinicians.

The present review focuses on mobile apps developed by the Department of Veterans Affairs (VA) National Center for PTSD (NCPTSD) and/or the Department of Defense (DoD) National Center for Technology & Telehealth (T2) to promote mental health in military and veteran populations. Compared with the general population, military and veteran populations have higher proportions of men, who are typically less willing than women to seek mental health treatment (e.g., Vogt, 2011). Mobile apps may help

Christine E. Gould, Palo Alto Geriatric Research, Education, and Clinical Center, VA Palo Alto Health Care System, Palo Alto, California, and Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine; Brian C. Kok, Vanessa K. Ma, and Aimee Marie L. Zapata, Palo Alto Geriatric Research, Education, and Clinical Center, VA Palo Alto Health Care System, Palo Alto, California, and Pacific Graduate School of Psychology, Palo Alto University; Jason E. Owen, National Center for PTSD, VA Palo Alto Health Care System, Menlo Park, California; Eric Kuhn, National Center for PTSD, VA Palo Alto Health Care System, Menlo Park, California, and Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine.

This work was supported by the Department of Veterans Affairs Rehabilitation Research and Development (IK2 RX001478; PI Christine E. Gould) and by Ellen Schapiro and Gerald Axelbaum through a 2014 NARSAD Young Investigator Grant from the Brain and Behavior Research Foundation (PI Christine E. Gould). Views expressed in this article are those of the authors and not necessarily those of the Department of Veterans Affairs or the Federal Government.

Correspondence concerning this article should be addressed to Christine E. Gould, Veterans Affairs Palo Alto Health Care System, Palo Alto Geriatric Research, Education, and Clinical Center (182B), 3801 Miranda Avenue, Palo Alto, CA 94304. E-mail: christine.gould@va.gov

destigmatize mental health care, as well as facilitate the dissemination of evidence-based treatments to broader populations (Reger et al., 2013). The VA/DoD suite of mobile apps is unique in that it (1) was developed for noncommercial purposes by teams including health care professionals; (2) is available on iOS and Android platforms; and (3) is free to download and without in-app purchases. Several of the VA/DoD apps share similar graphic-interfaces and menu systems, which may facilitate user's comfort with the apps. Additionally, the VA/DoD apps offer accessibility features (e.g., VoiceOver, Zoom on iPhone, subtitles on videos) to increase access to individuals with disabilities.

Previous mental health app reviews summarize the available evidence for specific problems (e.g., smoking cessation; Whittaker, McRobbie, Bullen, Rodgers, & Gu, 2016) or across mental health problems in general (e.g., Bakker, Kazantzis, Rickwood, & Rickard, 2016; Luxton et al., 2011; Van Ameringen, Turna, Khalesi, Pullia, & Patterson, 2017). Two reviews discuss the utility of military mental health apps (Armstrong, Hoyt, Kinn, Ciulla, & Bush, 2017; Shore et al., 2014); however, neither provides a systematic review of the available evidence for the VA/DoD mental health apps. Those reviews acknowledge that while many of the VA/DoD apps are based on empirically supported theories and treatments, evidence in support of the apps themselves is lacking.

In addition to limited outcome-related data, data on clinician adoption and utilization of these apps is minimal, with utilization rates likely varying across treatment setting and by presenting issue/diagnosis. Torous and Roberts (2017) point out that ethical and legal considerations may influence clinician adoption of apps in treatment. For example, when apps are used in a health care context, storage of health-related data on a patient's phone may raise questions about privacy and security. Clinicians who recommend the use of apps to clients should have a good understanding of: (1) how the app collects and records data (e.g., passive capture vs. user entry); (2) how data are stored long-term (e.g., on device or cloud-based server); and (3) any potential sharing of data with third-party entities (e.g., electronic medical records). The DoD has developed a best practice guide to support active ongoing training of the DoD clinicians in using apps to assist in providing mental health care. The VA is currently setting up similar implementation efforts through its Provider Based Implementation Network to ensure that clinicians have access to high quality training materials. Despite these efforts in supporting clinicians, both patients and clinicians may face other potential barriers to widespread app use, such as data usage limitations, limited wireless internet access, and low penetration of smartphone ownership among some groups (e.g., older individuals; Smith, 2017).

In this systematic review of VA/DoD apps, we discuss the theoretical basis for each app (when available) and summarize each app's core features and functions. For those apps that have been the subject of empirical research, we summarize the extant evidence on feasibility, usability, efficacy, and/or effectiveness.

Method

Mobile App Selection Criteria

Our review focused on the VA/DoD mental health or behavioral health apps with a mental health component. We categorized each app into one of two groups: self-management apps and treatment companion apps. Self-management apps are used independently by patients as self-help interventions or with support from a provider as guided self-help interventions. Treatment companion apps are designed to accompany a specific evidence-based treatment and are intended for use by patients only with the guidance of a mental health professional. Our review included peer-reviewed studies of VA/DoD mental health (or behavioral health) apps that reported original data on (1) the usability, acceptability, feasibility, efficacy or effectiveness of the app(s), or (2) clinician attitudes toward the app(s). We define usability studies as those that provide data from users on the accessibility or technical functionality of the app. Usability study participants are not necessarily drawn from a clinical sample. Acceptability refers to the patient perceptions that the given app would be acceptable/tolerable to a specific clinical population. These acceptability data could be found in survey studies or case series. Evidence of feasibility would require that an app be used by patients on their own (i.e., not solely in a laboratory setting; see Czajkowski et al., 2015 for behavioral treatment development). Often feasibility studies may use a case-series design. Efficacy studies would report on the effect of an app (intervention) compared with a control condition in an ideal setting. In contrast, effectiveness studies establish whether the app (intervention) is superior to a comparison condition in a "real world" or clinical setting (i.e., pragmatic studies; Areán & Kraemer, 2013).

Search Strategy

We identified articles using an aggregated research interface (EBSCOhost) that searched the following databases: PsycARTICLES, PsycBOOKS, Psychology and Behavioral Sciences Collection, PsycINFO, eBook Collection (EBSCOhost), MEDLINE, PsycTESTS, PsycEXTRA, Health Source: Consumer Edition, Health Source: Nursing/Academic Edition, Academic Search Complete. The main search string included 18 of 20 VA/DoD mental health-related apps: ("ACT Coach") *OR* ("Breathe2Relax") *OR* ("CBT-i Coach" *OR* "CBTi Coach" *OR* "CBT i Coach") *OR* ("CPT Coach") *OR* ("DreamEZ" *OR* "Dream EZ") *OR* ("Life Armor") *OR* ("Mindfulness Coach") *OR* ("Mood Coach") *OR* ("PE Coach") *OR* ("Positive Activity Jackpot") *OR* ("PTSD Family Coach") *OR* ("PTSD Coach") *OR* ("STAIR Coach") *OR* ("Stay Quit Coach") *OR* ("T2 Mood Tracker") *OR* ("Tactical Breather") *OR* ("VET Change") *OR* ("Virtual Hope Box"). Due to the ubiquity of the phrase "moving forward," a separate search was conducted for the Moving Forward app: ("Moving Forward") *AND* ("app" or "mobile application"). A similar stand-alone search was conducted for the Anger and Irritability Management Skills (AIMS) app. No articles were found for either app. Each app search was also conducted in Google Scholar and PubMed (to identify any articles not yet indexed in MEDLINE). The main search string returned 48 unique articles; 5 additional articles were identified via Google Scholar. As an additional check, the reference lists of recent mHealth review articles (i.e., Armstrong et al., 2017; Bakker et al., 2016; Luxton et al., 2011; Shore et al., 2014) were examined for additional articles; however, no articles were identified. Three other articles were identified by coauthors familiar with the subject matter. Literature searches were conducted in May 2017, and updated in November 2017.

Article review occurred in two phases. First, authors reviewed the title and abstract for all 56 articles to determine relevance and

initial eligibility. Articles with unclear or ambiguous abstracts were retained for additional review. Twenty-four articles were removed at this phase: 6 were unrelated (e.g., no mention of relevant apps); 12 were from nonacademic periodicals, blogs, or news outlets, 5 were from non-peer-reviewed sources (i.e., poster/presentations, dissertations), and 1 was an erratum to an earlier article. The remaining 32 articles were reviewed in full by at least two authors to establish eligibility. Ten articles were excluded at this second review phase. Five articles were excluded because they did not present original data (i.e., reviews or commentaries). Two articles described the development or implementation of an app without reporting data. Two articles were excluded because they reported findings from a single intervention testing multiple apps together and failed to report data at the app level. One article was excluded because it described secondary analysis of an article already included and did not report data related to the app. This left 22 articles to be included in the final review.

Data Abstraction

Each article was reviewed independently by at least two coauthors. Data were collected regarding type of study, sample size, participant population, follow-up period, measures/assessments, and summary of findings.

App Evaluation

The second step of the review process was to summarize the features and functions of each app. Four authors (Christine E. Gould, Brian C. Kok, Vanessa K. Ma, Aimee Marie L. Zapata) reviewed the apps and identified available features (e.g., psychoeducation, skills, self-assessments). Each author spent a minimum of 1 hr with each app, exploring one or more features within each section, and determining whether the app interacts with other smartphone features. App features and the theoretical underpinnings are summarized in the results, prior to reviewing the available research evidence of each app.

Results

Twenty-two published articles met criteria inclusion criteria. These articles reported on 8 of the 20 publicly available VA/DoD apps: Breathe2Relax, PTSD Coach, PTSD Family Coach, T2 Mood Tracker, Virtual Hope Box, CBT-I Coach, PE Coach, and Stay Quit Coach. The articles demonstrated substantial variability in terms of the sample characteristics, duration of app use, and study design. Nineteen of the 22 studies directly evaluated an app with users (patients or clinicians), whereas the remaining 3 studies consisted of a cost-analysis (Luxton, Hansen, & Stanfill, 2014), data-informed app development (Owen et al., 2017), or evaluation of app downloads, usage, and user experience (Owen et al., 2015). The variability in study designs can be observed in Tables 1 and 2. The duration of the participants' use of the apps ranged from 3 days to 6 months ($M = 8.19$, $SD = 6.52$ weeks). Participants included college students, community-dwelling adults, active-duty service members, veterans, and clinicians. Many of the study samples consisted of participants who were at risk for disorders (i.e., elevated symptoms on questionnaires) and/or seeking treatment currently. Most studies used at least one psychometrically sound self-report outcome measure, with the exception of provider survey studies that employed study-specific measures.

Self-Management Apps: Overviews and Published Evidence

Breathe2Relax.

App overview. The Breathe2Relax (B2R) app was launched by the DoD T2 to help users manage stress with diaphragmatic breathing (National Center for Telehealth & Technology, 2011a). The B2R app provides (1) psychoeducation about the biology of stress and effects of stress on the body; (2) visual and audio instructions for diaphragmatic breathing; and (3) tracking of stress before and after each session. Users may personalize the breathing instructions by adjusting the inhale and exhale duration and the number of breathing cycles per practice session. The user also can control the presence or absence of background music during the breathing session.

Research evidence. The only published study on B2R consisted of a summary app download data and theoretical cost-analysis of using the app for stress reduction compared with in-person care (Luxton et al., 2014). App usage was calculated for the 298,000 users who downloaded the app between 2011 and 2013. Most users (81.1%; $n = 242{,}800$) accessed the app for less than 10-min sessions, 15.8% ($n = 47{,}000$) accessed the app for 10-to-30-min sessions, and 2.8% ($n = 8{,}200$) accessed the app for more than 30-min sessions. Luxton et al. (2014) also estimated the cost-effectiveness of in-person breathing training compared with the B2R app. The B2R app became more cost-effective than in-person training with larger numbers of patients (i.e., $>$ 1,500 to 1,600). Estimated savings based on the 47,000 users who accessed the app for 10-to-30-min would be $2.7 million if those users were assumed to be military service members, or $2.9 million if those users were assumed to be civilians. To date, no studies provide evidence of usability, feasibility, acceptance, or efficacy for B2R.

PTSD Coach.

App overview. PTSD Coach (Hoffman et al., 2011[1]), designed by the VA NCPTSD in conjunction with the DoD T2, provides psychoeducation and skills to reduce PTSD symptoms. PTSD Coach uses interventions based on CBT therapies for PTSD such as stress inoculation training (SIT; Meichenbaum, 1974), identification of stressful reactions, challenging negative thoughts, thought stopping, and relaxation techniques. The app has four main sections: Learn, Self-Assessment, Manage Symptoms, and Find Support. The Learn section provides psychoeducation about PTSD symptoms and effective treatments. The Self-Assessment section uses the PTSD Checklist-Civilian version (PCL-C; Weathers, Huska, & Keane, 1991) to allow users to assess and track PTSD symptom severity. The Manage Symptoms section provides tools, such as audio-guided progressive muscle relaxation (PMR), self-coping statements, leisure activity planning, isolation reduction suggestions, and grounding exercises. The Subjective Units of Distress Scale (SUDS) is used to rate distress before and after using each tool. The Find Support section allows users to add existing telephone contacts and provides easy access to the National Suicide Prevention Hotline/Veterans Crisis Line.

[1] Release dates are for iOS version of the apps.

Table 1
Research on Self-Management Apps

App	Authors/Journal	Study design	Study duration	Measures	Results
Breathe2Relax	Luxton, Hansen, and Stanfill (2014), *Journal of Telemedicine and Telecare*	*Cost analysis* Compared cost of in-person care to Breathe2Relax app. Estimated costs for 1,000 military patients and 1,000 civilian patients. Examined app downloads and usage	N/A	App downloads and usage Calculation of cost of care within military health care system and civilian health care system	Downloads: 298,000 users accessed app in 2.5 years since the app release. Military Costs: in-person: $68,820; app = $106,397. App treatment became less expensive than in-office treatment with ~1,600 users. Civilian Costs: in-person: $62,800; app = $96,397. App treatment became less expensive than in-office with ~1,500 users.
PTSD Coach	Keen & Roberts (2017), *Health Systems*	*Nonrandomized pre-post study (4 months)* 382 undergraduates (M = 22, Range = 17–50 years) Time 2 = 53 responses (14% response rate)	4 months	PCL-C, Life Events Checklist, Self-reported PTSD Coach use with modified 3-item.	PTSD Coach use was positively related to change in PTSD symptoms. Performance expectancy and social influence were related to PTSD Coach use, but not effort expectancy and facilitating conditions. PTSD symptoms were not related to PTSD Coach use.
	Kuhn, Greene, et al. (2014), *Military Medicine*	*Preliminary study* 45 veterans attending PTSD residential treatment program (M = 45.3, SD = 14.0 years)	3 days	PTSD Coach Survey* to assess usability and perceived helpfulness of app. Focus groups to gather qualitative feedback.	Most veterans were satisfied with application; lower satisfaction among smartphone nonowners vs. smartphone owners. No group differences in perceived usefulness of app.
	Kuhn et al. (2017), *Journal of Consulting and Clinical Psychology*	*Randomized controlled trial* 120 community-dwelling adults with exposure to traumatic event > 1 month and [mteq] 35 on PCL-C (M_{age}= 39.28, SD = 14.64 years) PTSD Coach vs. Wait list	12 weeks	PCL-C, PTSD symptom self-efficiency*, PHQ-8, Brief Inventory of Psychosocial Functioning (B-IPF), Life Events Checklist, PTSD Coach use	PTSD Coach condition had greater reduction than waitlist in PTSD symptoms, depressive symptoms, and improvement in functioning but means post-treatment did not differ by the two groups. Higher proportion of PTSD Coach participants had clinical significant improvement on PCL ≥ 10-point decrease) vs. WL.
	Miner et al. (2016), *Psychological Trauma: Theory, Research, Practice, and Policy*	*Randomized controlled trial* 49 community-dwelling adult trauma survivors with PCL ≥ 25 (M = 45.7, SD = 13.9 years) PTSD Coach vs. wait list with cross-over at month 2	1 month (Follow-up at 2 months)	PCL, 6 feasibility/ease-of-use questions (post); 5 acceptability/usefulness questions (post)	App was well-received. Sig reduction in PCL scores for PTSD Coach users (ITT and completers) not found in waitlist-only. Symptom reduction persisted at 1-month posttreatment. Found device owners responded better than device borrowers.

(*table continues*)

Table 1 (*continued*)

App	Authors/Journal	Study design	Study duration	Measures	Results
	Possemato et al. (2017), *General Hospital Psychiatry*	*Randomized controlled trial* 20 primary care veterans with positive PTSD screens (PC-PTSD Screen) and PCL ≥ 40 (M_{age} = 42, *SD* = 12 years) Self-Management (SM) PTSD Coach vs. Clinician-Supported (CS) PTSD Coach	8 weeks (Follow-up at 12 and 16 weeks)	Feasibility measures; Clinician fidelity and satisfaction with treatment, objective use data; PCL-S, PHQ-9, WHO-QOL-BREF, Health care utilization	Evidence of feasibility of PTSD Coach and using of clinician support. Both conditions yielded significant reductions in PCL scores, but between group change was not significant (*d* = .54). CS may improve patient outcomes in terms of decreases in PTSD symptoms (SM: 38% vs CS: 70% significant symptom reductions) and persistence to seek mental health treatment (SM: 40% vs. CS: 70%).
Virtual Hope Box	Bush et al. (2015), *Suicide and Life-Threatening Behavior*	*Case series, cross-over counter balanced design* 18 high risk-of-self-harm veterans enrolled in DBT with borderline PD, bipolar disorder, treatment refractory depression or PTSD (M_{age} = 41.4 years, *SD* = 8.6 years) Tested personalized conventional hope boxes (CHB) and virtual hope boxes (VHB) with order of testing randomized	6–8 weeks	Technology use questionnaire, semi-structured interview, use of app, functionality, understandability, overall impression, recommendations for future modifications, likelihood to use again, error/tech difficulties	More regular use of VHB vs. CHB; VHB was easy to set up, beneficial/helpful, likely to use in future, recommend.
	Bush et al. (2017), *Psychiatric Services*	*Randomized controlled trial* 118 veterans in MH care (2 visits within 6 months) who expressed suicide ideation within 3 months prior to recruitment (M = 46.81, *SD* = 13.80 years) VHB vs enhanced usual care (EUC; printed materials) both groups had clinician support	12 weeks	Coping Self-efficacy Scale, Beck Scale for Suicidal Ideation, Brief Reasons for Living Inventory, Interpersonal Needs Questionnaire, Perceived Stress Scale, Columbia-Suicide Severity Rating Scale	VHB improved coping self-efficacy for pleasant thoughts and emotions. No differences in coping efficacy for support. No advantage of VHB vs. EUC for suicide severity measures or perceived stress. Modest but significant improvements for both these measures.
T2 Mood Tracker	Bush, Ouellette, and Kinn (2014), *Military Medicine*	*Preliminary study* 8 soldiers receiving behavioral health treatment at Warrior Transition Unit (age not reported)	2–3 weeks	Experience with personal technologies, T2 Mood Tracker use, usability, and benefits, recommendations for improvement of the app. T2 Mood Tracker records.	6 of 8 soldiers used app 2–4 times/week. 7 of 8 found app to be very useful and beneficial, 5 of 8 would use the app in the future, 6 of 8 would recommend the app to others.

Note. Two mixed methods studies are described in text, but not reported in table (Owen et al., 2015, 2017). DBT = Dialectical Behavior Therapy; ITT = Intent-to-treat; PCL = Posttraumatic Stress Disorder Checklist (PCL-C for civilians; PCL-S for weekly assessments); PHQ-8 = Patient Health Questionnaire 8-item; PHQ-9 = Patient Health Questionnaire 9-item; PTSD = posttraumatic stress disorder; RCT = randomized controlled trial; WHO-QOL-BREF = World Health Organization Quality of Life Brief measure; WL = Waitlist.
* Indicates measure was created for study.

Table 2
Research on Treatment Companion Apps

App	Authors/Journal	Study design	Study duration	Measures	Results
CBT-I Coach	Babson, Ramo, Baldini, Vandrey, and Bonn-Miller (2015), *JMIR Res Protoc*	*Randomized case series* 4 veterans seeking treatment for cannabis use disorder (M_{age} = 47, SD = 16.3 years). CBT-I Coach vs. iOS Mood Tracker	2 weeks	Mobile App Use Measure; Pittsburg Sleep Quality Index (PSQI)	Veterans in CBT-I Coach condition used app daily for 2 weeks (5–10 min per day) and described the app favorably.
	Koffel et al. (2016), *Health Informatics Journal*	*Randomized controlled trial* 18 veterans (M_{age} = 48.5, SD = 14.9 years) CBT-I treatment as usual (TAU) vs. CBT-I supplemented with app	4–5 weeks	Pretreatment Technology Use Questionnaire; Insomnia Severity Index; VA Treatment Adherence Scale	No significant difference between CBT-I TAU and app-supplemented CBT-I on outcome (d = .21, n.s., favored TAU). Adherence favored app (d = .76, n.s.). Participants reported that sleep log and reminder functions were most helpful aspect, could help adherence.
	Kuhn et al. (2016), *Journal of Clinical Sleep Medicine*	*Clinician survey* Cross-sectional survey of CBT-I trained VA clinicians' attitudes. 138 clinicians responded to pre-release survey (M_{age} = 47.7, SD = 10.86 years) 176 clinicians responded to post-release survey	Survey at pre-release; 2 years after app release	Pre-release survey on personal tech use and preliminary attitudes toward CBT-I Coach; postsurvey assessed use of CBT-I Coach with patients	Pre-release: App was viewed very favorably. Post-release: 59.9% of clinicians reported using the app with at least one patient in the past 2 years; 44.9% use it with current patient.
	Miller et al. (2017), *Behavioral Sleep Medicine*	*Clinician survey* Cross-sectional survey of 108 CBT-I trained VA clinicians in national rollout (M_{age} = 48.53, SD = 11.56 years)	Survey 1 year after app release	Participant characteristics, CBT-I Coach use with patients, perceptions of CBT-I Coach	47% used app with ≥ 1 patient in past year. 98% of clinicians using app intended to continue using the app. 83% of clinicians not using app reported intending to use it in future. Perceived benefits of app: patient motivation, treatment compliance. Barriers to use: patient technology use/ownership, clinician lack of knowledge about app.
PE Coach	Kuhn, Eftekhari, et al. (2014), *Adm Policy Mental Health*	*Clinician survey* 163 PE-trained VA clinicians (Age range: 20–60+ years)	Survey before app release	22 items on perception of app relative advantage, compatibility, and complexity; 2 items on future use intention and endorsement	Perceptions were generally favorable but not very strong; younger (<40 years), smartphone ownership, and had previously used apps in care were more likely to be early adopters of app.
	Kuhn et al. (2015), *Professional Psychology: Research and Practice*	*Clinician survey* 271 PE-trained VA clinicians (M_{age} = 47.17, SD = 10.31 years)	Survey 1 year after app release	73 items on PE use and caseload, participant characteristics, smartphone ownership, PE Coach use/other app use in care. Also assessed relative advantage, compatibility, complexity, trialability, and observability	50% of clinicians who had seen at least 1 PE patient within past year had used PE Coach. Factors associated with PE Coach use include: number of PE patients seen in past 12 months, younger clinician age (<40), and clinician smartphone ownership.

(*table continues*)

Table 2 (*continued*)

App	Authors/Journal	Study design	Study duration	Measures	Results
	Reger, Skopp, Edwards-Stewart, and Lemus (2015), *Military Psychology*	*Case Series, within-subjects counterbalanced cross-over design* 2 Soldiers referred by behavioral health clinic (age not reported) 1 soldier used app in first 4 sessions; second soldier used app in last 4 sessions (Eight 90-minute PE sessions)	4-weeks use (Follow-up at 1 and 3 months)	Revised Behavior and Symptom Identification Scale-24 (BASIS-24); BAI; BDI-II; PCL-C; Comparison of PE Coach and traditional PE*; PE Coach satisfaction form	Soldiers rated PE Coach positively and reported higher satisfaction during PE with PE Coach as compared with PE alone.
	Reger et al. (2017), *Professional Psychology: Research and Practice*	*Quality improvement project using rapid ethnographic assessment (REA)* 25 PE-trained VA clinicians individually interviewed about a total of 450 PTSD patients (age not reported)	N/A	Semistructured interviews	Facilitators included: enhanced treatment credibility, convenience of and engagement in completing PE tasks, and provider-patient collaboration. Barriers included: technical challenges, differences between the iOS and Android versions, lack of awareness of app features, inability to share app data between patient and provider, and patients' lack of comfort and proficiency using mobile devices.
Stay Quit Coach	Hicks et al. (2017), *Journal of Dual Diagnosis*	*Randomized controlled trial* 11 smokers (10 cigarettes/day ≥ 1 year) with current PTSD (Age range = 18–70 years) 2-arm, computer-based RCT of [counseling/contingency management + app vs. counseling/ contingency management only]	3-month and 6-month follow-ups	CAPS, BDI-II, Morisky Adherence Questionnaire, Bioverfication. Stay Quit Coach evaluation (post), Timeline Followback Procedure (post)	App is feasible and acceptable as companion to treatment. Generally high ratings of helpfulness and satisfaction. App rated as most effective at helping quit smoking, remaining abstinent, and providing support and relevant information about quitting. 1 patient achieved abstinence at 6-months intervention with daily use of app.
	Herbst et al. (2018), *American Journal of Preventative Medicine*	*Uncontrolled pilot study* 20 veteran smokers with PTSD (M_{age} = 41.1, *SD* = 16.2 years) Integrated smoking cessation treatment plus app	8 weeks (Follow-up at 3 months)	PTSD Checklist, Fagerström Test for Nicotine Dependence, carbon monoxide bioverification, System Usability Scale	App is feasible and acceptable (moderate perceived usability rating for app). App promoted engagement and retention in treatment compared with previous study without app (65% vs. 47%).

Note. One validation study examining mobile administration of PCL on PE Coach is described in text, but not reported in table (Price, Kuhn, Hoffman, Ruzek, & Acierno, 2015). BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory; CAPS = Clinician-Administered PTSD Scale; CBT-I = Cognitive Behavior Therapy for Insomnia; PCL = Posttraumatic Stress Disorder Checklist for civilians; PE = prolonged exposure; RCT = randomized controlled trial; TAU = Treatment as usual.

Research evidence. PTSD clinicians and patients provided input in the design of the app prior to the conduct of a feasibility and acceptability study (Kuhn, Greene, et al., 2014). Patients in a PTSD residential program used the app over a 3-day period and then provided feedback on the app through surveys and focus groups. The majority (88.9%) of the sample endorsed moderate satisfaction or greater for PTSD Coach. While app satisfaction was higher for smartphone owners compared with nonowners, there were no differences in the perceived helpfulness ratings. In a mixed methods study, Owen and colleagues (2015) examined consumer feedback and usage trends in 15,000 sessions of PTSD Coach. Their findings indicated that PTSD Coach is reaching users with at least moderate symptoms of PTSD and the app appears to be effective at reducing momentary distress, as evidenced by reductions in SUDS. Additionally, three RCTs have been conducted with the app (Kuhn et al., 2017; Miner et al., 2016; Possemato et al., 2016). Two RCTs found that PTSD Coach reduced PTSD symptom severity compared to waitlist control conditions in community samples, with effect sizes of $d = .25$ (*n*.s.) after 1 month (Miner et al., 2016) and .41 ($p < .05$) after 3 months of use (Kuhn et al., 2017). Kuhn et al. (2017) also found that PTSD Coach significantly reduced depressive symptoms and improved psychosocial functioning. In the third RCT, Possemato et al. (2016) compared the effects of the PTSD Coach app (self-management) with PTSD Coach plus clinician support in a VA primary care setting. Both conditions resulted in significant declines in PTSD symptoms. Although a higher percentage of the clinician-support group (70%) achieved clinically significant improvement compared with the self-management group (38%), this difference was not statistically significant. Participants in the clinician-supported condition were also more likely to seek mental health treatment (70%) compared with self-management (40%). Preliminary efficacy of PTSD Coach also has been demonstrated in a 4-month nonrandomized prepost study with college students by independent researchers (Keen & Roberts, 2017). To date, no studies have investigated the effectiveness of the app.

PTSD Family Coach.

App overview. The PTSD Family Coach app (Hoffman et al., 2015), designed by the VA NCPTSD and the DoD T2, provides information about PTSD to partners, family members, and other individuals who want to support their loved one with PTSD. The app contains extensive information about what PTSD is, how it may affect the family/children/partners of the individual with PTSD, and how to help a loved one manage their PTSD symptoms. Additional features include an assessment of stress, resources for support, and tools to help family members manage their own issues (e.g., stress, safety concerns, parenting difficulties, anger/irritation).

Research evidence. Only one study (Owen et al., 2017) examined PTSD Family Coach to date. The authors conducted a mixed methods study of 212 caregivers of veterans with PTSD to assess their overall need for help (using ratings of caregiver burden) and specific needs as part of the app development. Specific needs identified were management of veteran's PTSD symptoms, relationship issues, health care support, caregiver burden, and caregiver safety. In the article, researchers described the existing app resources that met caregivers' needs and identified additional resources to be developed in PTSD Family Coach. No studies provide evidence of the usability, efficacy, or effectiveness for PTSD Family Coach.

T2 Mood Tracker.

App overview. The T2 Mood Tracker (National Center for Telehealth & Technology, 2011b), developed by the DoD T2, allows users to track symptoms across six domains: anxiety, depression, general well-being, head injury, posttraumatic stress, and stress. Within each domain, various emotions are presented on a scale with a slider to use to track one's emotional state. Users may customize rating categories to track other relevant issues (e.g., pain, sleep). The mood tracking results can be graphed to show changes over time and can be downloaded as a report. Users may also set reminders track their symptoms.

Research evidence. Bush, Ouellette, and Kinn (2014) conducted a field test of T2MT with 8 soldiers receiving treatment for physical or psychological wounds at a Warrior Transitional Unit (WTU). App usage was tracked over 2 to 3 weeks. Most users reported that they would use the app in the future, recommend it to others, and share the information on the app with their provider (See Table 1). Comments from WTU clinicians indicated enthusiasm about the potential of the T2MT in treatment, especially with regards to the app's ability to track multiple issues. No studies have established the efficacy or effectiveness of the T2MT app.

Virtual Hope Box.

App overview. Virtual Hope Box (VHB; National Center for Telehealth & Technology, 2014) was developed by the DoD T2 to provide skills to manage negative thoughts and feelings, particularly in the context of suicidal ideation. The app is a digital version of a hope box (also called a *hope kit* or *hope chest*), which is a therapeutic tool used to used to instill hope in patients experiencing emotional distress and suicidal ideation (Wenzel, Brown, & Beck, 2009). A physical hope box may contain physical reminders of reasons for living, such as pictures of family members/friends, inspirational items (e.g., prayer cards, quotes), and music (Wenzel & Jager-Hyman, 2012). VHB serves the same function with the added benefits of portability and the ability to include digital content (e.g., videos, pictures, songs). The app also offers games for distraction, relaxation tools, and the ability to contact emergency services (i.e., Veterans Crisis Line, 911) if needed.

Research evidence. Bush and colleagues (2015) described the development of the VHB app and conducted a case series to examine the overall usability of the app compared with a conventional hope box. The main finding was that participants assigned to use VHB in the cross-over design used it more frequently compared to the conventional hope box. VHB also was evaluated in an RCT of 118 veterans who had experienced suicidal ideation in the past 3-month (Bush et al., 2017). Veterans in the VHB condition had significant improvements in coping self-efficacy for emotions and thoughts compared with veterans in the enhanced usual care condition. No studies offer evidence of the effectiveness of VHB.

Treatment Companion Apps: Overviews and Published Evidence

CBT-I Coach.

App overview. CBT-I Coach (Hoffman, Taylor, et al., 2013) was developed by the VA NCPTSD in conjunction with Stanford University Medical Center and the DoD T2. The app is intended to augment in-person cognitive–behavioral therapy for insomnia

(CBT-I), an evidence-based treatment that has strong research support for treating chronic insomnia (Karlin, Trockel, Taylor, Gimeno, & Manber, 2013). App content covers five components of CBT-I: sleep hygiene, stimulus control, sleep restriction, relaxation techniques, and maladaptive thoughts about sleep. The app has two main assessment features: self-reported sleep tracking (i.e., a sleep diary), and the Insomnia Severity Index (ISI; Morin, 1993). The sleep diary feature prompts users to enter data about their sleep behaviors each day, and tracks users' sleep patterns over time using graphs. CBT-I Coach includes interventions to reduce arousal and worry before bedtime, such as relaxation exercises and cognitive techniques.

Research evidence. Two cross-sectional surveys were conducted to assess provider attitudes before and after the release of CBT-I Coach (Kuhn et al., 2016; Miller et al., 2017). Before the app's release, VA clinicians trained in CBT-I reported that the features (e.g., sleep diary, homework reminders) would likely help increase patient engagement and adherence to the therapy (Kuhn et al., 2016). In the postrelease survey, app-using clinicians indicated that they believed it helped with homework adherence and overall outcomes. Regarding utilization, 60% of surveyed clinicians reported using the app within the past 2 years with at least one patient, and 45% reported currently using the app with a CBT-I patient (Kuhn et al., 2016). One year after the release of the app, 47% of CBT-I trained VA clinicians surveyed reported using the app with one or more patients within the past year and 98% of those clinicians intended to continue using the app (Miller et al., 2017). Eighty-three percent of clinicians who did not currently use the app reported that they intended to use it in the future. Clinicians perceived that benefits to app use were increased patient motivation and greater treatment compliance. Barriers to app use included patients not having smartphones or not being comfortable with technology, and clinicians not being comfortable with or knowledgeable about the app.

The feasibility of using CBT-I Coach in conjunction with traditional therapy delivery was examined in a pilot RCT (Koffel et al., 2018) conducted in a VA CBT-I clinic. Patients were randomly assigned to CBT-I plus-app ($n = 9$) or CBT-I as usual ($n = 9$). Findings indicate that the app was well received by patients, and dropout was lower in the CBT-I Coach condition ($n = 0$) than the nonapp condition ($n = 3$). A large effect size ($d = .76$, *ns*) for increased homework adherence favored the app condition. Another study examined the app in a case-series of cannabis users ($N = 4$) with comorbid insomnia (Babson, Ramo, Baldini, Vandrey, & Bonn-Miller, 2015). Two participants used CBT-I Coach and 2 used a nonsleep based mood-tracking app for 2 weeks. CBT-I Coach was reported to be user-friendly and helpful. In both studies (Babson et al., 2015; Koffel et al., 2018), participants reported that the ability to record and track their sleep was the most helpful aspect of the app. To date, no studies provide evidence of the efficacy or effectiveness of CBT-I Coach.

PE Coach.

App overview. Developed in 2012 by VA NCPTSD and the DoD T2, PE Coach (Reger et al., 2013) is designed for patients to use during Prolonged Exposure (PE) treatment (Foa, Hembree, & Rothbaum, 2007), an efficacious evidence-based trauma-focused PTSD therapy (e.g., Powers, Halpern, Ferenschak, Gillihan, & Foa, 2010). Features of PE Coach include psychoeducation about common reactions to trauma, information about PE, assessments, tools to support homework (e.g., audio recording feature and homework reminders), and a breathing retraining tool. Reger and colleagues (2013) suggested that the audio recording feature provides a more convenient and accessible playback option for patients during imaginal exposures. The pace of breathing retraining exercises may be customized by the user. Homework completion and timed activity usage may be reviewed by clinicians and patients by using the patient's phone during session. Assessments include the PCL, PHQ-9 (iOS only), and SUDS assessments to log distress related to exposure exercises.

Research evidence. Three studies examined VA-trained PE clinicians' perceptions of PE Coach (Kuhn, Eftekhari, et al. 2014; Kuhn et al., 2015; Reger et al., 2017). In the survey completed prior to the release of PE Coach, researchers identified characteristics of clinicians who intended to use the app (Kuhn, Eftekhari, et al., 2014). Clinician characteristics associated with increased intent to use the app were: age less than 40 years, smartphone ownership, and previous experience with apps in treatment. Clinicians intending to use PE Coach viewed the app as (1) providing an advantage over conventionally delivered PE; and (2) not being too complex or time consuming to use. In a survey conducted a year after PE Coach was released, 50% of a sample of VA PE-trained clinicians, who treated at least one PE patient within the past year, currently used PE Coach (Kuhn et al., 2015). Of the clinicians currently using PE Coach, 93.6% indicated that they would continue to use it. Three factors were associated with PE Coach use: (1) the number of PE patients seen in the past 12 months; (2) younger clinician age; (3) and smartphone ownership. In a third study, researchers conducted qualitative interviews with PE-trained clinicians using PE Coach (Reger et al., 2017). The clinicians perceived that the app strengthened treatment credibility for patients, increased patient accountability and privacy, and provided convenience and consolidation of treatment forms. Clinicians identified technical and connectivity issues, feature differences between the Android and iOS versions, low technological literacy (patient), and lack of user data restoration following software updates as barriers to app use.

Researchers examined the experiences of two active duty soldiers with current PTSD undergoing PE when using and not using PE Coach to obtain patient feedback on PE Coach (Reger, Skopp, Edwards-Stewart, & Lemus, 2015). The soldiers rated PE Coach positively and found it to be engaging, easy to use, convenient, and helpful with regards to homework completion, tracking progress, and relaxation. A separate study compared the PCL feature of PE Coach with the PCL completed on paper (Price, Kuhn, Hoffman, Ruzek, & Acierno, 2015). The authors demonstrated equivalence for app administration of the PCL relative to when it was administered on paper (Price et al., 2015). To date, no studies of PE Coach provide evidence of efficacy or effectiveness for the app.

Stay Quit Coach.

App overview. Stay Quit Coach (Hoffman, Kuhn, Wald, & Ruzek, 2013) was developed by the VA NCPTSD, VA Tobacco & Health: Policy & Programs in the Clinical Public Health Group (CPH), VA VISNs 21 and 6 Mental Illness Research, Education, and Clinical Center (MIRECC), and the DoD T2. The Stay Quit Coach app follows the evidence-based smoking cessation practices in treating veterans with comorbid nicotine use and PTSD (McFall et al., 2010). Veterans with PTSD are more likely to smoke as a coping mechanism for PTSD symptoms and have a more difficult

time quitting compared to veterans without PTSD. Stay Quit Coach provides relapse prevention support, reminders for taking smoking cessation medication, and immediate coping strategies to resist cravings and avoid habitual smoking-behaviors. The app offers psychoeducation on smoking and quitting, customized smoking cessation plans, motivational messages (some of which are timed to the quit date), and access to support contacts and hotlines.

Research evidence. To date, two studies have examined Stay Quit Coach. In a pilot RCT, 11 smokers were randomized to receive either (1) mobile-delivered contingency management (QUIT4EVER), medications, and Stay Quit Coach, or (2) mobile-delivered contingency management (QUIT4EVER) and medications (Hicks et al., 2017). Participants perceived that Stay Quit Coach was helpful in quitting smoking. High rates of relapse during follow-up were observed for both conditions. One participant who achieved abstinence at 6 months used Stay Quit Coach daily throughout the 6 months, which authors surmised may have contributed to the participant's abstinence. In an uncontrolled pilot trial, 20 veteran smokers with PTSD received 8 weekly integrated care treatment sessions for smoking cessation, which included PTSD-informed cognitive–behavioral therapy, pharmacotherapy, and Stay Quit Coach (Herbst et al., 2018). Stay Quit Coach was found to be feasible and at least moderately acceptable to veteran participants. Additionally, compared with a previous trial of the integrated treatment for smoking cessation, the inclusion of Stay Quit Coach yielded increased attendance rates for the 8 sessions (65% vs. 47%). To date, no studies offer evidence of the efficacy or effectiveness for Stay Quit Coach.

Discussion

The VA and the DoD have an impressive suite of apps related to mental and behavioral health issues common in-service members, veterans, and the general population. These apps vary in terms of their core features, intended uses, and presentations, but all are grounded in a strong theoretical evidence base and are free to download and use. Our review findings demonstrate that the largest amount of evidence in support of apps is for the feasibility and acceptability of the apps. One strength of these studies is the use of clinical samples (i.e., treatment seeking, elevated symptoms). Research support for efficacy and effectiveness of the apps is more limited and needs further attention.

The self-management apps have received the most research attention in terms of efficacy. This is potentially due to the earlier release dates of self-management apps and greater ease of study compared with the treatment companion apps. For example, conducting psychotherapy trials large enough to detect incremental benefits of adding a treatment companion app compared with treatment without the app can be prohibitively expensive. Consequently, most extant treatment companion app research studies relied on clinician surveys. The few small studies that examined the treatment companion apps with patients focused on acceptance of the apps and whether the apps enhanced treatment (i.e., session attendance, homework adherence).

Self-management apps were found to be popular (i.e., high number of downloads) and appear to be well received by patients. Despite the high number of downloads, there is still a lack of evidence of efficacy for the majority of the VA/DoD apps. Two apps, however, have been shown to reduce symptoms (PTSD Coach) and promote self-efficacy (Virtual Hope Box) in controlled studies. PTSD Coach is the most researched app of those reviewed, with six published studies, including three RCTs. Virtual Hope Box has been examined in two controlled studies (RCT and case series cross-over design). More research is needed to investigate the efficacy of the other self-management apps. Thus, clinicians should be careful not to overstate their potential benefits when recommending these apps to patients as stand-alone interventions. An interesting direction of research on the self-management apps is regarding whether coaching or clinician-support may enhance the effects of mobile apps. In a pilot RCT, Possemato et al. (2016) found potential advantages of providing clinician support with PTSD Coach app over use of the app alone (with a medium effect size), although the finding was not statistically significant. The DoD T2's website (http://t2health.dcoe.mil/products/mobile-apps) offers clinician and user manuals for some self-management apps as well. Further research is needed on the effects of including clinician support and on how best to incorporate these apps into care.

Treatment companion apps are intended to facilitate provision of evidence-based treatments, (e.g., ease of homework completion and practice of coping skills), thereby potentially increasing patient engagement and improving outcomes (e.g., Reger et al., 2017). At present, the majority of studies on these apps are clinician surveys or underpowered RCTs. Clinician surveys of CBT-I Coach and PE Coach show that clinicians have positive attitudes toward these apps and are routinely using them in practice. Findings also indicate that clinicians believe that the apps increase various aspects of patient adherence to the protocols and possibly improve outcomes. This finding dovetails with that of Koffel et al. (2018) in which the app-supplemented CBT-I group had greater treatment adherence than treatment as usual (TAU), although the difference was not significant. Survey findings suggest that clinician characteristics may influence whether apps are incorporated into care (Kuhn et al., 2015, 2016; Miller et al., 2017). Younger age, smartphone ownership, and knowledge about the apps were factors associated with clinician adoption of apps into practice. The limited data on patient perceptions of these apps indicate that the apps are perceived favorably, and integrating apps into treatment may improve attitudes toward the treatment itself (Reger et al., 2015, 2017). Despite this support, treatment companion apps lack robust research evidence directly demonstrating improved therapy adherence and enhanced treatment outcomes.

Limitations to the studies reviewed include small sample sizes, lack of rigorous control conditions (e.g., attention-placebo controls), variability in duration of app use, and heterogeneous inclusion/exclusion criteria across studies. Most study participants were young to middle-aged adults, reflecting the skew of smartphone ownership (Smith, 2017). As smartphone ownership continues growing among those 50 years and older (Smith, 2017), there may be a need for training to help these new adopters learn how to optimally use apps. This is further supported by the findings that smartphones-naïve users did not appear to benefit as much as those familiar with the devices (Kuhn, Greene, et al., 2014; Miner et al., 2016). Future research should recruit older participants or participants with functional impairment to investigate whether these characteristics moderate app usage or efficacy. Overall, the body of evidence in support of apps is limited by the small number of studies that evaluated efficacy (i.e., symptom reduction and/or improvement in quality of life). The literature would also benefit from studies conducted by independent researchers who were not involved in the app's development. As future studies become more rigorous

and have less variability in the study designs, future systematic reviews should use grading schemes to compare the research evidence for each app.

This systematic review documents an emerging body of evidence suggesting benefits of several VA/DoD mobile apps. The apps could be incorporated at a variety of time-points along the care continuum, including before, during, or after treatment. These apps have the potential to support patient autonomy through symptom management, increase treatment engagement, augment psychotherapy, or to assist with relapse prevention. Moreover, new models of mental health care based on the inclusion of apps may need to be developed and evaluated to assess effectiveness and cost savings to the health care system. Only one of the reviewed studies (Luxton et al., 2014) provides preliminary support for cost savings of using apps versus in person treatment to teach skills such as diaphragmatic breathing when more than 1,500 patients are treated. Research on cost-effectiveness is critical as these apps are incorporated into patient care.

In addition to calling for more rigorous research on the clinical use and efficacy of these apps, the present review hopes to emphasize the potential advantages of using mental health apps. Apps can facilitate clinician-patient collaboration, are convenient to patients, and are deemed to be easy to use by both patients and clinicians. Additionally, apps have the potential to integrate with objective data such as sensor data (e.g., actigraphy and psychophysiological measurements), GPS/location tracking, and other future data sources. The integration of multiple data sources may further enhance mental health evaluation and treatment. At the same time, allowing apps to access features of one's smartphone raises issues regarding privacy, data sharing, and data protection. While additional studies and RCTs are clearly needed to better understand the potential benefits of using mobile health technology to address mental health concerns, early results show considerable promise of these technologies.

References

* Reference was included in systematic review.

Areán, P. A., & Kraemer, H. C. (2013). *High-quality psychotherapy research: From conception to piloting to national trials*. New York, NY: Oxford University Press. http://dx.doi.org/10.1093/med:psych/9780199782468.001.0001

Armstrong, C. M., Hoyt, T., Kinn, J. T., Ciulla, R. P., & Bush, N. E. (2017). Mobile behavioral health applications for the military community: Evaluating the emerging evidence base. *Best Practices in Mental Health: An International Journal, 13,* 106–119.

*Babson, K. A., Ramo, D. E., Baldini, L., Vandrey, R., & Bonn-Miller, M. O. (2015). Mobile app-delivered cognitive behavioral therapy for insomnia: Feasibility and initial efficacy among veterans with cannabis use disorders. *JMIR Research Protocols, 4,* e87. http://dx.doi.org/10.2196/resprot.3852

Bakker, D., Kazantzis, N., Rickwood, D., & Rickard, N. (2016). Mental health smartphone apps: Review and evidence-based recommendations for future developments. *JMIR Mental Health, 3,* e7. http://dx.doi.org/10.2196/mental.4984

*Bush, N. E., Dobscha, S. K., Crumpton, R., Denneson, L. M., Hoffman, J. E., Crain, A., . . . Kinn, J. T. (2015). A Virtual Hope Box smartphone app as an accessory to therapy: Proof-of-concept in a clinical sample of veterans. *Suicide and Life-Threatening Behavior, 45,* 1–9. http://dx.doi.org/10.1111/sltb.12103

*Bush, N. E., Ouellette, G., & Kinn, J. (2014). Utility of the T2 Mood Tracker mobile application among army warrior transition unit service members. *Military Medicine, 179,* 1453–1457. http://dx.doi.org/10.7205/MILMED-D-14-00271

*Bush, N. E., Smolenski, D. J., Denneson, L. M., Williams, H. B., Thomas, E. K., & Dobscha, S. K. (2017). A Virtual Hope Box: Randomized controlled trial of a smartphone app for emotional regulation and coping with distress. *Psychiatric Services, 68,* 330–336. http://dx.doi.org/10.1176/appi.ps.201600283

Czajkowski, S. M., Powell, L. H., Adler, N., Naar-King, S., Reynolds, K. D., Hunter, C. M., . . . Charlson, M. E. (2015). From ideas to efficacy: The ORBIT model for developing behavioral treatments for chronic diseases. *Health Psychology, 34,* 971–982. http://dx.doi.org/10.1037/hea0000161

Foa, E. B., Hembree, E. A., & Rothbaum, B. O. (2007). *Treatments that work. Prolonged exposure therapy for PTSD: Emotional processing of traumatic experiences: Therapist guide*. New York, NY: Oxford University Press. http://dx.doi.org/10.1093/med:psych/9780195308501.001.0001

*Herbst, E., Pennington, D., Kuhn, E., McCaslin, S. E., Delucchi, K., Batki, S. L., . . . Carmody, T. (2018). Mobile technology for treatment augmentation in veteran smokers with posttraumatic stress disorder. *American Journal of Preventive Medicine, 54,* 124–128. http://dx.doi.org/10.1016/j.amepre.2017.08.016

*Hicks, T. A., Thomas, S. P., Wilson, S. M., Calhoun, P. S., Kuhn, E. R., & Beckham, J. C. (2017). A preliminary investigation of a relapse prevention mobile application to maintain smoking abstinence among individuals with posttraumatic stress disorder. *Journal of Dual Diagnosis, 13,* 15–20. http://dx.doi.org/10.1080/15504263.2016.1267828

Hoffman, J. E., Kuhn, E., Wald, L. H., & Ruzek, J. I. (2013). Stay Quit Coach (Version 1.0) [Mobile application software]. Retrieved from http://itunes.apple.com

Hoffman, J. E., Taylor, K., Manber, R., Trockel, M., Gehrman, P., Woodward, S., . . . Ruzek, J. I. (2013). CBT-I Coach (Version 1.0). [Mobile application software]. Retrieved from http://itunes.apple.com

Hoffman, J. E., Wald, L. J., Kuhn, E., Greene, C., Ruzek, J. I., & Weingardt, K. (2011). PTSD Coach (Version 1.0). [Mobile application software]. Retrieved from http://itunes.apple.com

Hoffman, J. E., Wald, L. H., Owen, J. E., Kuhn, E., Jaworski, B. K., Ramsey, K. M., & Iverson, K. (2015). PTSD Family Coach (Version 2.0). [Mobile application software]. Retrieved from http://myvaapps.com

Karlin, B. E., Trockel, M., Taylor, C. B., Gimeno, J., & Manber, R. (2013). National dissemination of cognitive behavioral therapy for insomnia in veterans: Therapist- and patient-level outcomes. *Journal of Consulting and Clinical Psychology, 81,* 912–917. http://dx.doi.org/10.1037/a0032554

*Keen, S. M., & Roberts, N. (2017). Preliminary evidence for the use and efficacy of mobile health applications in managing posttraumatic stress disorder symptoms. *Health Systems, 6,* 122–129. http://dx.doi.org/10.1057/hs.2016.2

*Koffel, E., Kuhn, E., Petsoulis, N., Erbes, C. R., Anders, S., Hoffman, J. E., . . . Polusny, M. A. (2018). A randomized controlled pilot study of CBT-I Coach: Feasibility, acceptability, and potential impact of a mobile phone application for patients in cognitive behavioral therapy for insomnia. *Health Informatics Journal, 24,* 3–13.

*Kuhn, E., Crowley, J. J., Hoffman, J. E., Eftekhari, A., Ramsey, K. M., Owen, J. E., . . . Ruzek, J. I. (2015). Clinician characteristics and perceptions related to use of the PE (Prolonged Exposure) Coach mobile app. *Professional Psychology: Research and Practice, 46,* 437–443. http://dx.doi.org/10.1037/pro0000051

*Kuhn, E., Eftekhari, A., Hoffman, J. E., Crowley, J. J., Ramsey, K. M., Reger, G. M., & Ruzek, J. I. (2014). Clinician perceptions of using a smartphone app with prolonged exposure therapy. *Administration and Policy in Mental Health and Mental Health Services Research, 41,* 800–807. http://dx.doi.org/10.1007/s10488-013-0532-2

*Kuhn, E., Greene, C., Hoffman, J., Nguyen, T., Wald, L., Schmidt, J., . . . Ruzek, J. (2014). Preliminary evaluation of PTSD Coach, a smartphone app for post-traumatic stress symptoms. *Military Medicine, 179,* 12–18. http://dx.doi.org/10.7205/MILMED-D-13-00271

*Kuhn, E., Kanuri, N., Hoffman, J. E., Garvert, D. W., Ruzek, J. I., & Taylor, C. B. (2017). A randomized controlled trial of a smartphone app for posttraumatic stress disorder symptoms. *Journal of Consulting and Clinical Psychology, 85,* 267–273. http://dx.doi.org/10.1037/ccp0000163

*Kuhn, E., Weiss, B. J., Taylor, K. L., Hoffman, J. E., Ramsey, K. M., Manber, R., . . . Trockel, M. (2016). CBT-I Coach: A description and clinician perceptions of a mobile app for cognitive behavioral therapy for insomnia. *Journal of Clinical Sleep Medicine, 12,* 597–606. http://dx.doi.org/10.5664/jcsm.5700

*Luxton, D. D., Hansen, R. N., & Stanfill, K. (2014). Mobile app self-care versus in-office care for stress reduction: A cost minimization analysis. *Journal of Telemedicine and Telecare, 20,* 431–435. http://dx.doi.org/10.1177/1357633X14555616

Luxton, D. D., McCann, R. A., Bush, N. E., Mishkind, M. C., & Reger, G. M. (2011). mHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Professional Psychology: Research and Practice, 42,* 50–54. http://dx.doi.org/10.1037/a0024485

McFall, M., Saxon, A. J., Malte, C. A., Chow, B., Bailey, S., Baker, D. G., . . . the CSP 519 Study Team. (2010). Integrating tobacco cessation into mental health care for posttraumatic stress disorder: A randomized controlled trial. *Journal of the American Medical Association, 304,* 2485–2493. http://dx.doi.org/10.1001/jama.2010.1769

Meichenbaum, D. (1974). *Cognitive behavior modification*. Morristown, NJ: General Learning Press.

*Miller, K. E., Kuhn, E., Owen, J. E., Taylor, K., Yu, J. S., Weiss, B. J., . . . Trockel, M. (2017). Clinician perceptions related to the use of the CBT-I coach mobile app. *Behavioral Sleep Medicine*. Advance online publication. http://dx.doi.org/10.1080/15402002.2017.1403326

*Miner, A., Kuhn, E., Hoffman, J. E., Owen, J. E., Ruzek, J. I., & Taylor, C. B. (2016). Feasibility, acceptability, and potential efficacy of the PTSD Coach app: A pilot randomized controlled trial with community trauma survivors. *Psychological Trauma: Theory, Research, Practice and Policy, 8,* 384–392. http://dx.doi.org/10.1037/tra0000092

Morin, C. M. (1993). *Insomnia: Psychological assessment and management*. New York, NY: Guilford Press.

National Center for Telehealth & Technology. (2011a). Breathe2Relax (Version 1.7). [Mobile application software]. Retrieved from http://t2health.dcoe.mil/apps/breathe2relax

National Center for Telehealth & Technology. (2011b). T2 Mood Tracker (Version 3.5). [Mobile application software]. Retrieved from http://t2health.dcoe.mil/apps/t2-mood-tracker

National Center for Telehealth & Technology. (2014). Virtual Hope Box (Version 1.4). [Mobile application software]. Retrieved from http://t2health.dcoe.mil/apps/virtual-hope-box

*Owen, J. E., Jaworski, B. K., Kuhn, E., Hoffman, J. E., Schievelbein, L., Chang, A., . . . Rosen, C. (2017). Development of a mobile app for family members of veterans with PTSD: Identifying needs and modifiable factors associated with burden, depression, and anxiety. *Journal of Family Studies*. Advance online publication. http://dx.doi.org/10.1080/13229400.2017.1377629

*Owen, J. E., Jaworski, B. K., Kuhn, E., Makin-Byrd, K. N., Ramsey, K. M., & Hoffman, J. E. (2015). mHealth in the wild: Using novel data to examine the reach, use, and impact of PTSD Coach. *JMIR Mental Health, 2,* e7. http://dx.doi.org/10.2196/mental.3935

Possemato, K., Kuhn, E., Johnson, E. M., Hoffman, J. E., & Brooks, E. (2017). Development and refinement of a clinician intervention to facilitate primary care patient use of the PTSD Coach app. *Translational Behavioral Medicine, 7,* 116–126. http://dx.doi.org/10.1007/s13142-016-0393-9

*Possemato, K., Kuhn, E., Johnson, E., Hoffman, J. E., Owen, J. E., Kanuri, N., . . . Brooks, E. (2016). Using PTSD Coach in primary care with and without clinician support: A pilot randomized controlled trial. *General Hospital Psychiatry, 38,* 94–98. http://dx.doi.org/10.1016/j.genhosppsych.2015.09.005

Powers, M. B., Halpern, J. M., Ferenschak, M. P., Gillihan, S. J., & Foa, E. B. (2010). A meta-analytic review of prolonged exposure for posttraumatic stress disorder. *Clinical Psychology Review, 30,* 635–641. http://dx.doi.org/10.1016/j.cpr.2010.04.007

*Price, M., Kuhn, E., Hoffman, J. E., Ruzek, J., & Acierno, R. (2015). Comparison of the PTSD Checklist (PCL) administered via a mobile device relative to a paper form. *Journal of Traumatic Stress, 28,* 480–483. http://dx.doi.org/10.1002/jts.22037

*Reger, G. M., Browne, K., Campellone, T. R., Simons, C., Kuhn, E., Fortney, J. C., . . . Schacht Reisinger, H. S. (2017). Barriers and facilitators to mobile application use during PTSD treatment: Clinician adoption of PE Coach. *Professional Psychology: Research and Practice, 48,* 510–517. http://dx.doi.org/10.1037/pro0000153

Reger, G. M., Hoffman, J., Riggs, D., Rothbaum, B. O., Ruzek, J., Holloway, K. M., & Kuhn, E. (2013). The "PE coach" smartphone application: An innovative approach to improving implementation, fidelity, and homework adherence during prolonged exposure. *Psychological Services, 10,* 342–349. http://dx.doi.org/10.1037/a0032774

*Reger, G. M., Skopp, N. A., Edwards-Stewart, A., & Lemus, E. L. (2015). Comparison of prolonged exposure (PE) coach to treatment as usual: A case series with two active duty soldiers. *Military Psychology, 27,* 287–296. http://dx.doi.org/10.1037/mil0000083

Shore, J. H., Aldag, M., McVeigh, F. L., Hoover, R. L., Ciulla, R., & Fisher, A. (2014). Review of mobile health technology for military mental health. *Military Medicine, 179,* 865–878. http://dx.doi.org/10.7205/MILMED-D-13-00429

Smith, A. (2017). *Record shares of Americans now own smartphones, have home broadband*. Retrieved from http://www.pewresearch.org/fact-tank/2017/01/12/evolution-of-technology/

Torous, J., & Roberts, L. W. (2017). The ethical use of mobile health technology in clinical psychiatry. *Journal of Nervous and Mental Disease, 205,* 4–8. http://dx.doi.org/10.1097/NMD.0000000000000596

Van Ameringen, M., Turna, J., Khalesi, Z., Pullia, K., & Patterson, B. (2017). There is an app for that! The current state of mobile applications (apps) for *DSM–5* obsessive-compulsive disorder, posttraumatic stress disorder, anxiety and mood disorders. *Depression and Anxiety, 34,* 526–539. http://dx.doi.org/10.1002/da.22657

Vogt, D. (2011). Mental health-related beliefs as a barrier to service use for military personnel and veterans: A review. *Psychiatric Services, 62,* 135–142. http://dx.doi.org/10.1176/ps.62.2.pss6202_0135

Weathers, F. W., Huska, J. A., & Keane, T. M. (1991). *PCL-C for DSM–IV*. Boston, MA: National Center for PTSD-Behavioral Science Division.

Wenzel, A., Brown, G. K., & Beck, A. T. (2009). *Cognitive therapy for suicidal patients: Scientific and Clinical Applications*. Washington, DC: American Psychological Association. http://dx.doi.org/10.1037/11862-000

Wenzel, A., & Jager-Hyman, S. (2012). Cognitive therapy for suicidal patients: Current status. *Behavior Therapist, 35,* 121–130.

Whittaker, R., McRobbie, H., Bullen, C., Rodgers, A., & Gu, Y. (2016). Mobile phone-based interventions for smoking cessation. *Cochrane Database of Systematic Reviews, 4,* CD006611.

World Health Organization. (2012). *Mobile health (mHealth)*. Retrieved from http://www.whoint/goe/mobile_health/en/

Received June 29, 2017
Revision received May 22, 2018
Accepted May 28, 2018 ■